AFCAPS-FR-2012-0007

Estimating Air Force Specialty Final School Grades and Washout Rates

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December 8, 2008

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25FEB12
PA Review: Cleared for Public Release
Air Force Personnel Center; Office of Public Affairs
PA: Ms Paige Hughes

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REPORT DOCUMENTATION PAGE

1. REPORT DATE (dd-mm-yy)	2. REPORT TYPE	3. DATES COVERED (from. . . to)
08-12-08	Final	December 2008

4. TITLE AND SUBTITLE	5a. CONTRACT OR GRANT NUM
Estimating Air Force Specialty Final School Grades and Washout Rates	FA3089-06-F-0550
	5b. PROGRAM ELEMENT NUMBER: DAFM14
6. AUTHOR(S)	5c. PROJECT NUMBER
Tirso E. Diaz and Michael Ingerick	5d. TASK NUMBER
	5e. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)	8. PERFORMING ORGANIZATION REPORT NUMBER
HumRRO 66 Canal Center Plaza, Ste 400 Alexandria, VA 22314	FR-08-53
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. MONITOR ACRONYM
AFPC/DSYX 550 C Street West, Suite 45 Randolph AFB, Texas 78150	11. MONITOR REPORT NUMBER AFCAPS-TR-2012-0007

12. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for Public Release. Distribution Unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT *(Maximum 200 words)*:

The U.S. Air Force (USAF) Classification Decision Support System (CDSS) is a software tool that enables USAF personnel decision-makers to evaluate the effects of alternative minimum aptitude standards on several critical personnel outcomes for a targeted Air Force Specialty (AFS). The analyses underlying two of these outcomes, Final School Grade (FSG) and School Failure Rates, use a regression-based model for predicting the average FSG and academic-related washout behavior of airmen using aptitude composite (i.e., MAGE) scores and demographics as predictors. To ensure consistency across the two outcomes, a single combined model is used to estimate both outcomes for a targeted AFS. The purpose of this study was to update and enhanced the FSG-washout prediction model using more recent and more complete data from USAF's Technical Training Management System (TTMS).

15. SUBJECT TERMS

CDSS, FSG, Washout, Washback, TTMS

SECURITY CLASSIFICATION OF			19. LIMITATION OF ABSTRACT	20. NUMBER OF PAGES	21. RESPONSIBLE PERSON
16. REPORT	17. ABSTRACT	18. THIS PAGE			
Unclassified	Unclassified	Unclassified	Unlimited	32	Kenneth L. Schwartz (210) 565-3139

Standard Form 298

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Estimating Air Force Specialty (AFS) Final School Grades and Washout Rates

Executive Summary

The U.S. Air Force (USAF) Classification Decision Support System (CDSS) is a software tool that enables USAF personnel decision-makers to evaluate the effects of alternative minimum aptitude standards on several critical personnel outcomes for a targeted Air Force Specialty (AFS). The analyses underlying two of these outcomes, Final School Grade (FSG) and School Failure Rates, use a regression-based model for predicting the average FSG and academic-related washout behavior of airmen using aptitude composite (i.e., MAGE) scores and demographics as predictors. To ensure consistency across the two outcomes, a single combined model is used to estimate both outcomes for a targeted AFS. The purpose of this study was to update and enhanced the FSG-washout prediction model using more recent and more complete data from USAF"s Technical Training Management System (TTMS).

For each AFS, we estimated the regression parameters of the combined FSG-Washout prediction model using technical school performance data for the AFS obtained from the USAF"s TTMS. The model combined the FSGs of airmen who successfully passed technical training and the pass/fail data of airmen who washed out, using a censored regression framework. The FSG-washout prediction model was estimated using technical school data from 2002 through 2006, representing over 100,000 airmen across all AFS.

Overall, the predictive accuracy of the estimated combined FSG-Washout model was strong based on comparisons of the average observed and predicted FSG and washout rates. The differences between the average observed and the predicted FSG were generally small, with absolute differences less than 0.5 for most AFSs and a range of -0.9 to 3.3. The differences between the observed and predicted washout rates were similarly small, about one percentage point or less for most AFSs, with a range of -2.6% to 9.1%. However, there were a few AFS for which high washback rates or small variability in the upper range of FSG distribution appeared to have contributed to relatively large differences between actual and predicted average FSG and/or washout rates. The analysis of criterion-related validity estimates (R) also showed that the model demonstrated high predictive efficacy. When correcting for both AFS selection and shrinkage, the average cross-validated validity estimate was .48 across all AFS. Excluding four AFS with adjusted validity estimates of zero, the cross-validated validity estimates for the remaining AFS range from .18 to .78.

As implemented in CDSS, the estimated FSG-Washout model will be applied to compute the mean predicted FSG and washout rate of airmen meeting the minimum aptitude standard or cut score for a targeted AFS. For a given cut score, the mean predicted FSG for an AFS is computed by averaging the predicted FSGs of all airmen meeting the cut score, regardless of their actual AFS, using the estimated regression parameters for the AFS. The predicted washout rate is computed by averaging the washout probabilities of airmen meeting the cut score, regardless of actual AFS and washout status, using the estimated regression parameters for the AFS. The procedures for computing the mean predicted FSG and washout rates are described in detail in the report.

Estimating Air Force Specialty (AFS) Final School Grades and Washout Rates

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ESTIMATING AIR FORCE SPECIALTY (AFS) FINAL SCHOOL GRADES AND WASHOUT RATES

Overview

The U.S. Air Force (USAF) Classification Decision Support System (CDSS) is a software tool that enables USAF personnel decision-makers to evaluate the effects of alternative minimum aptitude standards on several critical personnel outcomes for a targeted Air Force Specialty (AFS). The analyses underlying two of these outcomes, Final School Grade (FSG) and School Failure Rates, use a regression-based model for predicting the average FSG and academic-related washout behavior of airmen using aptitude composite (i.e., MAGE) scores and demographics as predictors. To ensure consistency across the two outcomes, a single combined model is used to estimate both outcomes for a targeted AFS. The objective of the effort summarized in this report was to update and enhance the model currently implemented in CDSS using more recent and more complete data from USAF‟s Technical Training Management System (TTMS). The updated model combined the FSGs of airmen who successfully passed technical training and the pass/fail data of airmen who washed out, using a censored regression framework to ensure that the estimated FSG regression model is unbiased.[1]

The report is organized as follows. First, we describe and specify the enhanced FSG-washout prediction model implemented in the latest version of CDSS (v 3.1). Second, we summarize how the prediction model was estimated using five years‟ worth of AFS-awarding technical school performance (2002-2006) representing over 100,000 airmen. Third, we report the results of the model, specifically how the predicted values compare to observed average FSG and washout rates by AFS. Finally, we conclude the report by summarizing how the model can be applied to estimate the average FSG and washout rates of airmen that qualify for a targeted AFS given some minimum aptitude standard (or cut score). The parameter estimates for the prediction model by AFS are reported in Appendix A.

Estimating the Enhanced FSG-Washout Prediction Model

Overview of the Combined Prediction Model

As discussed, the objective of this effort was to construct a model for predicting the average FSG and washout rates of airmen who meet the minimum aptitude standard(s) for an AFS. With the exception of two AFSs, a single model underlies the estimation of both average FSG and washout rate for a specified AFS.[2] This regression-based model predicts an airman‟s FSG and washout behavior based on his/her MAGE composite scores and select demographics (gender and race). For each AFS, regression parameters were estimated based on this model using the technical school performance data for the AFS obtained from the USAF‟s TTMS. Once

[1] As noted in the next section, in addition to academic-related washouts, we included washouts administratively recorded as medically related in estimating the regression model, thereby producing a slightly conservative estimate of academic-related school failure rates.

[2] For two AFS, 1C131 (Air Traffic Control) and 2A333 (Tactical A/C Maintenance), the washout behavior was modeled directly, because only a “pass/fail” training outcome was available.

estimated, and as implemented in CDSS, these parameters can then be applied to compute the mean predicted FSG and washout rate of airmen meeting the minimum aptitude standard for a targeted AFS.

Assumptions. We made certain assumptions to make the estimated model applicable to the larger sample of qualified airmen and to address other features of the technical school data (e.g., the absence of FSGs for airmen who failed technical training or who washed back). They were:

1. Average FSG is linearly related to airmen MAGE composite scores, with some differences that can be explained by airmen demographics.
2. Observed FSGs of individual airmen are normally distributed with a mean that lies on the regression line.
3. The factors that contribute to attrition from Basic Military Training (BMT) are independent of, or systematically unrelated to, technical training performance.
4. Unrecorded or unknown FSGs of airmen who failed technical school are censored from above relative to the passing FSG for the AFS (i.e., left censoring).
5. Airmen FSGs recorded as 99 or 100 are censored from below relative to an FSG of 99 (i.e., right censoring).
6. Academic and medical reasons for failing AFS-awarding training exhibit comparable relations with MAGE composite scores and airmen demographics.

The first two assumptions are based on standard assumptions made under a linear regression model. The third assumption makes it possible to estimate the parameters of the model using technical school data and then apply the estimated model to the larger sample of airmen that are qualified for an AFS based on its minimum aptitude standard(s).[3] The fourth and fifth assumptions are key improvements over the previous CDSS prediction model and address potential sources of bias in estimated parameters. Specifically, the inclusion of airmen who failed technical school in the estimation sample, even if numeric FSGs are unavailable, allows for the unbiased estimation of model parameters. The last assumption reflects our concern that some washouts recorded due to medical reasons may have been both academic and medical in nature. The estimation of academic washout rates continues to be the objective in the modeling, but in making this assumption, we are being conservative. Other reasons were not considered because the percentage of washouts attributable to any other non-academic reason was relatively small.

Limitations. In addition to the above assumptions, two sample-related limitations of the model should be noted. First, the average FSG and washout rates computed by CDSS could differ from the observed values that USAF personnel decision-makers are familiar with. There are two reasons for this: (a) FSG estimates of airmen who are predicted to washout and do not actually receive FSGs (or their FSGs are not reported in TTMS) are included in the computation of the average FSG under our model; and (b) the aptitude and demographic characteristics of the full sample of qualified airmen on which the CDSS estimates are based could differ from the

[3] Note that, although there is direct range restriction in the MAGE composite scores of airmen in technical school, this by itself does not make the estimated parameters biased.

sample of airmen actually assigned to an AFS.[4] A second limitation is that the model does not account for washbacks. The model instead treats washbacks as an integral part or component of the technical training process. Disentangling washbacks would result in an FSG model applicable only to airmen who go through technical training in one attempt. Practically, such a model would produce FSGs that are much lower, and washout rates that are much higher, than typically observed from AFS-awarding training.[5]

Model Specification. For all AFSs other than 1C131 and 2A333, the FSG obtained by airmen at the end of AFS-awarding technical training was modeled separately by AFS as:

$$Y = B_{const} + B_{Fem}X_{Fem} + B_M X_M + B_A X_A + B_G X_G + B_E X_E + \varepsilon$$

The dependent variable *Y* represents the FSG of a qualified airman. The *B*-parameters reflect the constant and coefficients in the regression model that were to be estimated. The *X* predictor variables consisted of dummy variables representing airmen demographics and their MAGE composite scores. The last component in the model is the regression error term ε, which was assumed to be normally distributed with zero mean and variance σ_ε^2 (i.e., mean-squared error in the model).

Table 1 lists the predictors included in the model and how they were defined. The predictors included in the model were limited to those for which data were available and for which there was sufficient variability to warrant their inclusion. For example, Education Tier was not included because of its lack of variation; close to 100% of enlisted airmen belong to Tier 1 (high school graduates). For three AFS (1C231, 1C431, 1T231) that were restricted to males only, and the gender dummy variable was not included in the model.

[4] These differences could arise because of several factors (e.g., AFS accession goals, airmen"s preferences for select AFS). One solution would be to generate a weighted sample that matches the aptitudes and demographics of the airmen actually assigned to an AFS (cf. Diaz, Ingerick & Sticha, 2004). This sample could be constructed using a job choice model that relates individual airmen characteristics to job attributes. Using the weights from this sample, one could then obtain estimates of the average FSG that more closely approximate the average FSG of airmen actually assigned to the AFS. In addition, this job choice model could be used to estimate cross-AFS effects resulting from changes in the minimum aptitude standard(s) for a single, targeted AFS. Such a job choice model is under development.

[5] A model for predicting washbacks is currently under consideration.

Table 1. Predictors and Their Definitions in the Regression Model

Predictor	Definition
X_{Fem}	Gender dummy variable; 1 = female, 0 = male
X_M	Score on Mechanical (M) aptitude composite
X_A	Score on Admin (A) aptitude composite
X_G	Score on General (G) aptitude composite
X_E	Score on Electrical (E) aptitude composite

As noted, airmen who fail to complete technical training are missing a FSG. This data feature was incorporated in the model by assuming that the FSGs of these airmen are censored from above. That is, the model assumes that the unmeasured FSG is below some fixed FSG required for passing the technical training of the AFS. To account for potential ceiling effects in model estimation, we also assumed that the FSG is censored from below if the observed value equals 99 or 100. We used SAS PROC LIFEREG to estimate the model (SAS Institute). PROC LIFEREG enables one to estimate a regression model when the dependent variable is censored from above or censored from below for some individuals. Data on the passing FSG used to determine if an airman passed technical training were not available. Further, preliminary analysis did not support a common passing FSG across AFS. To address this, we estimated the model using three different FSG passing values (70, 75, and 80). Then for each AFS, we selected the passing value that resulted in a predicted washout rate that most closely matched its observed rate.

For each AFS, the model produces the predicted FSG for a given airmen based on his/her demographics and MAGE composite scores using the estimated regression constants and coefficients specific to that AFS (see Appendix A). To obtain an airman‟s predicted washout behavior requires the estimated probability of his/her attaining an FSG that is below the passing value for a selected AFS. This estimated washout probability is given by

$$\hat{P}_{attr} = P(Y < PV) = \Phi\left(\frac{PV - \hat{Y}}{\hat{\sigma}_{\varepsilon}}\right).$$

where Φ is the standard normal cumulative probability function, $\hat{Y}$ is the predicted FSG for the airman, PV is the passing FSG value for the selected AFS, and $\hat{\sigma}_{\varepsilon}$ is the estimated standard deviation of the error term.[6] The average FSG and washout rates computed by CDSS simply represent the means of the $\hat{Y}$ ‟s and $\hat{P}_{attr}$ ‟s across the sample of airmen who qualify for the AFS given the minimum aptitude standard(s) specified. These computations are described in more detail in the final section of this report.

[6] Note that the washout model in this study is similar in form to a probit model of attrition. However, the „Y‟ variable in a probit model is unmeasured (latent) in the entire sample. In the current problem, „Y‟ (FSG) is measured for airmen who pass technical training and unmeasured for airmen who fail. The censored regression approach taken here, enables one to predict both the FSG and washout behavior of an airman using the same underlying model, ensuring consistency across the two outcomes.

For AFS 1C131 and 2A333, we directly modeled the washout probability $P(Y < PV)$ using the same predictor variables and linear model to characterize the latent performance criteria Y. We used SAS PROC PROBIT to estimate the constants and coefficients in the model. The estimates were subsequently rescaled to make them comparable to the other AFS, with washout probability computed relative to a passing value of 70. Note that the estimated models for AFSs 1C131 and 2A333 can only be used for estimating washout probabilities and not for computing FSG averages.

Estimation Data

The combined FSG-washout prediction model was estimated using technical school data from 2002 through 2006 (N = 103,431) obtained from USAF"s TTMS. Table 2 reports the AFS represented in the data. Table 3 shows the samples sizes and frequency distribution of the school status codes (i.e., graduated or washout) by AFS. Only major status code groups are reported in the table, specifically: (a) graduated (GEx), (b) academic washouts (LAx), (c) medical washouts (LMx), and (d) all other reasons for washing out combined (LOx). Compared to any of the other non-academic washouts, the proportion of medical washouts was relatively substantial (1.11% compared to, at most, 0.44% for any other reason reported in the total sample). We were also concerned with washouts that may have been both academic and medical in nature but technically recorded as medical washouts. For these reasons, we combined academic and medical washouts for purposes of estimating the FSG-washout model. The model was not estimated for AFS with small sample sizes (n < 74).

Table 2. AFS Included in the Sample

No.	AFS	Title
1	1A231	Aircraft Loadmaster
2	1A331	Airborne Communications and Electrical Systems
3	1A431	Airborne Battle Management Systems
4	1A531	Airborne Mission Systems
5	1A831	Airborne Cryptologic Linguist
6	1C031	Airfield Management
7	1C032	Aviaton Resource Management
8	1C131	Air Traffic Control
9	1C231	Combat Control
10	1C331	Command Post
11	1C431	Tactical Air Command and Control
12	1C531	Aerospace Control & Warning Systems
13	1C631	Space Systems Operations
14	1N031	Operations Intelligence
15	1N131	Imagery Analysis
16	1N332	Romance Cryptologic Linguist
17	1N333	Slavic Cryptologic Linguist
18	1N334	Far East Cryptologic Linguist
19	1N335	MidEast Cryptologic Linguist
20	1N431	Network Intelligence Analysis
21	1N531	Electronic Signal Intelligence Exploitation
22	1N631	Electronic Systems Security Assessment
23	1T131	Aircrew Life Support
24	1T231	Pararescue
25	1W031	Weather Forecaster
26	2A031	Avionics Test Station & Component
27	2A137	Electronic Warfare
28	2A331	A-10, F-15 & U-2 Avionics Systems
29	2A332	F-16, F-117, RQ-1, CV-22 Avionic Systems
30	2A333	Tactical A/C Maintenance
31	2A431	Aircraft Guidance
32	2A531	Aerospace Maintenance
33	2A533	Integrated Avionic Systems
34	2A631	Aerospace Propulsion
35	2A632	Aerospace Ground Equipment
36	2A633	Aircrew Egress Systems
37	2A634	A/C Fuel Systems
38	2A635	A/C Hydraulic Systems
39	2A636	A/C Electrical & Environmental Systems
40	2A731	A/C Metals Technology

Table 2. AFSs Included in the Sample (cont'd)

No.	AFS	Title
41	2A732	Nondestructive Inspection
42	2A733	A/C Structural Maintenance
43	2A734	Survival Equipment
44	2E031	Ground Radar Systems
45	2E131	Satellite, Wideband & Telemetry Systems
46	2E132	Meteorological & Nav Systems
47	2E133	Ground Radio Communications
48	2E231	Comm, Network Switching & Crypto Systems
49	2E632	Comm Cable & Antenna Systems
50	2E633	Voice Network Systems
51	2F031	Fuels
52	2G031	Logistics Plans
53	2M031	Missile & Space Systems Electrical Maintenance
54	2M032	Missile & Space Systems Maintenance
55	2M033	Missile & Space Facilities
56	2P031	Precision Measurement Equipment Lab
57	2R031	Maintenance Management Analysis
58	2R131	Maintenance Management Production
59	2S031	Supply Management
60	2S032	Supply Systems Analyst
61	2T031	Traffic Management
62	2T131	Vehicle Operations
63	2T231	Air Transportation
64	2T331	Vehicle & Vehicular Equipment Maintenance
65	2T332	Special Vehicle Maintenance
66	2T334	General Purpose Vehicle Maintenance
67	2T337	Vehicle Management Analysis
68	2W031	Munitions Systems
69	2W131	Aircraft Armament Systems
70	2W231	Nuclear Weapons
71	3A031	Information Management
72	3C031	Comm-Computer Systems Operators
73	3C032	Comm-Computer Systems Programmer
74	3C131	Radio Communication Systems
75	3C231	Comm - Computer Systems Control
76	3C331	Comm-Computer Systems Plans and Implementation
77	3E031	Electrical Systems
78	3E032	Electrical Power Production
79	3E131	HVAC & Refrigeration
80	3E231	Pavements & Construction Equipment

Table 2. AFSs Included in the Sample (cont'd)

No.	AFS	Title
81	3E331	Structural
82	3E431	Utilities Systems
83	3E432	Liquid Fuel Systems Maintenance
84	3E433	Environmental Controls
85	3E531	Engineering
86	3E631	Operations Management
87	3E731	Fire Protection
88	3E931	Readiness
89	3M031	Services
90	3P031	Security Forces
91	3S031	Personnel
92	4A031	Health Services Management
93	4A131	Medical Materiel
94	4A231	Biomedical Equipment
95	4C031	Mental Health Service
96	4D031	Diet Therapy
97	4J032	Physical Medicine
98	4V031	Optometry
99	4Y031	Dental Assistant
100	4Y032	Dental Lab
101	5R031	Chaplain Assistant
102	6C031	Contracting
103	6F031	Financial Management & Comptroller

Table 3. Sample Sizes and Frequency Distribution of Training School Status by AFS

			Frequency By Status				Percentage By Status			
No.	**AFS**	**Total**	**GEx**	**LAx**	**LMx**	**LOx**	**GEx**	**LAx**	**LMx**	**LOx**
1	1A231	82	81	1	0	0	98.8	1.2	0.0	0.0
2	1A331	671	630	31	6	4	93.9	4.6	0.9	0.6
3	1A431	538	524	6	1	7	97.4	1.1	0.2	1.3
4	1A531	152	147	2	2	1	96.7	1.3	1.3	0.7
5	1A831	200	196	0	4	0	98.0	0.0	2.0	0.0
6	1C031	338	318	16	0	4	94.1	4.7	0.0	1.2
7	1C032	637	606	24	2	5	95.1	3.8	0.3	0.8
8	1C131	2,013	1,672	169	62	110	83.1	8.4	3.1	5.5
9	1C231	221	157	4	6	54	71.0	1.8	2.7	24.4
10	1C331	822	789	19	0	14	96.0	2.3	0.0	1.7
11	1C431	630	443	34	59	94	70.3	5.4	9.4	14.9
12	1C531	785	769	6	1	9	98.0	0.8	0.1	1.1
13	1C631	298	274	18	0	6	91.9	6.0	0.0	2.0
14	1N031	1,480	1,224	215	22	19	82.7	14.5	1.5	1.3
15	1N131	609	564	33	6	6	92.6	5.4	1.0	1.0
16	1N332	101	95	0	1	5	94.1	0.0	1.0	5.0
17	1N333	170	164	2	1	3	96.5	1.2	0.6	1.8
18	1N334	187	181	0	2	4	96.8	0.0	1.1	2.1
19	1N335	181	177	1	1	2	97.8	0.6	0.6	1.1
20	1N431	764	631	95	5	33	82.6	12.4	0.7	4.3
21	1N531	437	405	20	0	12	92.7	4.6	0.0	2.7
22	1N631	234	224	8	0	2	95.7	3.4	0.0	0.9
23	1T131	758	737	15	0	6	97.2	2.0	0.0	0.8
24	1T231	91	85	1	0	5	93.4	1.1	0.0	5.5
25	1W031	1,067	952	88	5	22	89.2	8.2	0.5	2.1
26	2A031	861	813	19	2	27	94.4	2.2	0.2	3.1
27	2A137	95	93	1	0	1	97.9	1.1	0.0	1.1
28	2A331	883	856	7	0	20	96.9	0.8	0.0	2.3
29	2A332	1,136	1,083	15	4	34	95.3	1.3	0.4	3.0
30	2A333	4,278	4,248	1	8	21	99.3	0.0	0.2	0.5
31	2A431	74	66	7	1	0	89.2	9.5	1.4	0.0
32	2A531	4,424	4,350	41	8	25	98.3	0.9	0.2	0.6
33	2A533	2,266	2,201	21	3	41	97.1	0.9	0.1	1.8
34	2A631	2,582	2,502	26	3	51	96.9	1.0	0.1	2.0
35	2A632	1,919	1,713	144	6	56	89.3	7.5	0.3	2.9
36	2A633	532	521	9	0	2	97.9	1.7	0.0	0.4
37	2A634	1,176	1,154	10	4	8	98.1	0.9	0.3	0.7
38	2A635	881	864	5	1	11	98.1	0.6	0.1	1.2
39	2A636	1,865	1,794	35	2	34	96.2	1.9	0.1	1.8
40	2A731	399	381	3	3	12	95.5	0.8	0.8	3.0

Table 3. Sample Sizes and Frequency Distribution of Training School Status by AFS (cont'd)

			Frequency By Status				Percentage By Status			
No.	**AFS**	**Total**	**GEx**	**LAx**	**LMx**	**LOx**	**GEx**	**LAx**	**LMx**	**LOx**
41	2A732	422	367	47	2	6	87.0	11.1	0.5	1.4
42	2A733	1,478	1,426	13	8	31	96.5	0.9	0.5	2.1
43	2A734	354	342	3	0	9	96.6	0.8	0.0	2.5
44	2E031	309	297	7	1	4	96.1	2.3	0.3	1.3
45	2E131	848	824	13	0	11	97.2	1.5	0.0	1.3
46	2E132	264	254	8	0	2	96.2	3.0	0.0	0.8
47	2E133	1,248	1,187	45	0	16	95.1	3.6	0.0	1.3
48	2E231	1,338	1,238	87	0	13	92.5	6.5	0.0	1.0
49	2E632	133	127	0	4	2	95.5	0.0	3.0	1.5
50	2E633	574	569	1	0	4	99.1	0.2	0.0	0.7
51	2F031	2,056	2,034	8	3	11	98.9	0.4	0.1	0.5
52	2G031	78	78	0	0	0	100.0	0.0	0.0	0.0
53	2M031	552	511	3	1	37	92.6	0.5	0.2	6.7
54	2M032	306	282	5	0	19	92.2	1.6	0.0	6.2
55	2M033	231	191	18	0	22	82.7	7.8	0.0	9.5
56	2P031	341	320	17	0	4	93.8	5.0	0.0	1.2
57	2R031	268	258	4	1	5	96.3	1.5	0.4	1.9
58	2R131	373	368	2	2	1	98.7	0.5	0.5	0.3
59	2S031	2,680	2,610	26	21	23	97.4	1.0	0.8	0.9
60	2S032	119	110	3	2	4	92.4	2.5	1.7	3.4
61	2T031	731	703	8	5	15	96.2	1.1	0.7	2.1
62	2T131	1,042	1,036	2	0	4	99.4	0.2	0.0	0.4
63	2T231	2,566	2,546	3	6	11	99.2	0.1	0.2	0.4
64	2T331	530	519	3	2	6	97.9	0.6	0.4	1.1
65	2T332	374	362	3	3	6	96.8	0.8	0.8	1.6
66	2T334	302	300	1	1	0	99.3	0.3	0.3	0.0
67	2T337	168	166	0	0	2	98.8	0.0	0.0	1.2
68	2W031	3,627	3,579	23	4	21	98.7	0.6	0.1	0.6
69	2W131	3,682	3,549	66	11	56	96.4	1.8	0.3	1.5
70	2W231	469	413	12	3	41	88.1	2.6	0.6	8.7
71	3A031	2,507	2,420	73	3	11	96.5	2.9	0.1	0.4
72	3C031	2,421	2,291	103	9	18	94.6	4.3	0.4	0.7
73	3C032	585	548	33	0	4	93.7	5.6	0.0	0.7
74	3C131	202	196	5	0	1	97.0	2.5	0.0	0.5
75	3C231	908	771	123	2	12	84.9	13.5	0.2	1.3
76	3C331	210	182	27	0	1	86.7	12.9	0.0	0.5
77	3E031	667	566	57	20	24	84.9	8.5	3.0	3.6
78	3E032	700	688	8	2	2	98.3	1.1	0.3	0.3
79	3E131	601	531	60	2	8	88.4	10.0	0.3	1.3
80	3E231	455	446	1	1	7	98.0	0.2	0.2	1.5

Table 3. Sample Sizes and Frequency Distribution of Training School Status by AFS (cont'd)

			Frequency By Status				Percentage By Status			
No.	**AFS**	**Total**	**GEx**	**LAx**	**LMx**	**LOx**	**GEx**	**LAx**	**LMx**	**LOx**
81	3E331	467	453	5	2	7	97.0	1.1	0.4	1.5
82	3E431	580	565	10	0	5	97.4	1.7	0.0	0.9
83	3E432	169	161	6	0	2	95.3	3.6	0.0	1.2
84	3E433	74	74	0	0	0	100.0	0.0	0.0	0.0
85	3E531	206	205	1	0	0	99.5	0.5	0.0	0.0
86	3E631	178	178	0	0	0	100.0	0.0	0.0	0.0
87	3E731	1,738	1,531	107	51	49	88.1	6.2	2.9	2.8
88	3E931	423	388	26	1	8	91.7	6.1	0.2	1.9
89	3M031	2,148	2,059	34	22	33	95.9	1.6	1.0	1.5
90	3P031	16,688	15,064	524	732	368	90.3	3.1	4.4	2.2
91	3S031	1,515	1,492	17	3	3	98.5	1.1	0.2	0.2
92	4A031	1,452	1,447	1	2	2	99.7	0.1	0.1	0.1
93	4A131	536	528	8	0	0	98.5	1.5	0.0	0.0
94	4A231	267	169	93	2	3	63.3	34.8	0.7	1.1
95	4C031	325	309	10	0	6	95.1	3.1	0.0	1.8
96	4D031	229	227	2	0	0	99.1	0.9	0.0	0.0
97	4J032	100	92	8	0	0	92.0	8.0	0.0	0.0
98	4V031	95	94	1	0	0	98.9	1.1	0.0	0.0
99	4Y031	980	923	46	4	7	94.2	4.7	0.4	0.7
100	4Y032	126	108	1	1	16	85.7	0.8	0.8	12.7
101	5R031	123	123	0	0	0	100.0	0.0	0.0	0.0
102	6C031	340	319	14	2	5	93.8	4.1	0.6	1.5
103	6F031	1,116	1,067	36	2	11	95.6	3.2	0.2	1.0
	Overall	103,431	97,465	3,023	1,174	1,769	94.2	2.9	1.1	1.7

Results from Estimating the Combined FSG-Washout Model

Table 4 shows an overview of the estimation results. The results reported are based on the passing FSG value selected for an AFS shown under the column labeled *PV*. The table compares the observed (or actual) average FSG and washout rates to the average FSG and washout rates predicted from the model by AFS. We do not report the average FSG results for AFSs 1C131 and 2A333, because only pass/fail status were available for these two AFS. Note that the actual observed washout rates reported in the table correspond to academic and medical washouts.

Overall, the predictive accuracy of the estimated model was strong. The differences between the average observed and the predicted FSG were generally small.[7] Absolute differences were less than 0.5 for most AFSs with a range of -0.9 to 3.3. Airmen who were missing FSG and excluded in computing the average FSG were mostly washouts; while this is expected to lead to underestimation of the average FSG, it turned out to be a negligible fraction of the difference between observed and predicted FSGs. The three largest differences correspond to AFSs 4A231 (3.2), 1N431 (2.2), and 2A431 (1.4). As shown in the next column, AFS 4A231 has the highest observed washout rate (36%). On the other hand, AFSs 1N431 and 2A431 have the two highest washback rates among airmen who eventually pass (36% and 35%), as shown in Table 5; note that AFS 4A231 also has a moderately high washback rate (28%). Thus, it appears that much of the difference in observed and predicted FSG is attributable to washbacks (within an AFS).

With a few exceptions, differences between the observed and predicted washout rates were similarly small; about one percentage point or less for most AFSs with a range of -2.6% to 9.1%. The five largest differences between observed and predicted washout rates correspond to AFS 1N431 (9.1), 1C431 (6.8), 3E731 (5.9), 1C631 (4.7), and 1C231 (3.1). The actual washout rates for all five AFS are relatively large (6 to 17 percent), with predicted rates that underestimated the actual rates by 39 percent or more. As reported in Table 5, AFS 1N431 and 1C431 have two of the highest washback rates for airmen who eventually pass (36% and 33%), while AFS 3E731 has a moderately high washback rate (27%). While washback was not an issue for AFS 1C631, the variability of observed FSGs was relatively small, with 61% of airmen receiving a grade of 90 or better. There were four additional AFS with small but non-negligible actual washout rates between 2 and 3.5 percent (1A831, 2E63, 2W231, and 2A031), with predicted rates that were practically zero; the variability of the observed FSGs for these AFSs was small, with 62% to 90% of airmen receiving a grade of 90 or better. Lastly, we also note AFS 3E531, with 60% of airmen who earned non-numeric passing grades. For this AFS, the model over predicted the washout rate by 2.6 points over the actual rate of 0.5 percent.

In sum, the overall accuracy of the estimated combined FSG-Washout model was strong based on comparisons of the average observed and predicted FSG and washout rates. However, there were a few AFS for which high washback rates or small variability in the upper range of FSG distribution appeared to have contributed to relatively large differences between actual and predicted average FSG and/or washout rates.

[7] Unlike in traditional least-squares regression, the averages of the actual and predicted criterion are not expected to be equal in the combined FSG-washout model.

The table also reports four criterion-related validity estimates (*R*). The column "Uncorr" shows the uncorrected validity coefficient obtained by computing the correlation of the observed and predicted FSG based on the estimated combined FSG-Washout model. The validity estimates under this column are uncorrected in that these were computed from the restricted AFS samples of airmen with non-missing FSG. The next two columns, "Full AFS" and "USAF-wide", show the validity estimates obtained by applying a univariate correction for range-restriction to the uncorrected estimate (Sackett and Yang, 2000). Specifically, the column "Full AFS" shows the validities corrected to the sample of airmen representing the entire AFS (i.e., including airmen missing a FSG), whereas column "USAF-wide" shows the validities corrected to the total sample of airmen across all AFS.[8] Lastly, the column "USAF-wide-cv" shows the cross-validated validity estimates obtained by adjusting the validities corrected to the total sample across all AFS (i.e., under column "USAF-wide") using Rozeboom‟s (1978) shrinkage formula. Consistent with the comparisons between the observed and predicted FSG and washout values, the results show that the model demonstrated high predictive efficacy, with uncorrected validities ranging from .12 to .65 and an average of .41 across all AFS. When correcting for AFS selection, the validities range from .17 to .79, with an average of .52 across all AFS. After correcting for shrinkage, the average validity across all AFS went down slightly to .48. There were four AFS (1N332, 2G031, 2T334, and 4V031) with cross-validated validity estimates set to zero because their adjusted R-squared were negative. The cross-validated validity estimates for the remaining AFS range from .18 to .78. Overall, the levels of predictive efficacy exhibited by the model compares favorably with that typically obtained in personnel management research.

[8] In both cases, the correction for direct range-restriction was applied by treating airmen with observed FSGs as the selected sample. The „x‟ and „y‟ variables involved in the correction formula are the predicted FSG and the observed FSGs of airmen. The *unknown unrestricted variance* was computed from the predicted FSGs of airmen using: (a) the corresponding AFS sample only in the first correction ("AFS") and (b) using the total sample across AFS in the second correction ("Total"). Note that because the combined model indirectly accounted for (passing or failing) airmen with non-numeric FSG, the predicted FSGs are unbiased for the full AFS sample. Additionally, given an airman‟s MAGE composite scores and demographic characteristics, the model assumes the FSG to be independent of the classification process, and therefore the predicted FSGs are unbiased for the total sample across all AFS.

Table 4. Summary of Estimation Results for FSG and Washout by AFS

			FSG			Washout Rates			R			
No.	AFSC	PV	Actual	Pred	Diff	Actual	Pred	Diff	Uncorr	Full AFS	USAF-wide	USAF-wide-cv
1	1A231	70	91.2	90.8	0.4	1.2	0.0	1.2	0.55	0.55	0.66	0.60
2	1A331	80	86.2	86.6	-0.3	5.5	7.6	-2.0	0.43	0.43	0.64	0.63
3	1A431	80	89.8	89.8	0.0	1.3	1.6	-0.3	0.48	0.48	0.55	0.53
4	1A531	80	88.4	88.3	0.0	2.6	2.2	0.4	0.50	0.50	0.63	0.60
5	1A831	70	91.7	91.5	0.1	2.0	0.0	2.0	0.19	0.19	0.30	0.21
6	1C031	75	84.6	84.3	0.3	4.8	5.7	-1.0	0.39	0.38	0.42	0.39
7	1C032	70	84.1	83.5	0.6	4.1	2.2	1.9	0.29	0.29	0.39	0.37
8	1C131	70	n/a	n/a	n/a	12.1	12.1	0.0	n/a	n/a	n/a	n/a
9	1C231	80	88.1	87.9	0.1	6.0	2.9	3.1	0.53	0.53	0.61	0.57
10	1C331	75	88.3	87.9	0.4	2.4	1.5	0.8	0.35	0.35	0.41	0.39
11	1C431	80	85.5	85.9	-0.4	17.4	10.5	6.8	0.54	0.54	0.61	0.60
12	1C531	70	87.7	87.6	0.1	0.9	0.1	0.8	0.32	0.32	0.38	0.37
13	1C631	80	91.0	90.2	0.7	6.2	1.5	4.7	0.44	0.44	0.50	0.47
14	1N031	80	86.1	85.6	0.5	16.2	15.3	1.0	0.47	0.48	0.57	0.56
15	1N131	80	87.5	87.2	0.3	6.5	5.7	0.8	0.50	0.50	0.62	0.61
16	1N332	70	91.1	91.1	0.0	1.0	0.0	1.0	0.21	0.21	0.28	0.00
17	1N333	70	90.2	89.9	0.3	1.8	0.0	1.8	0.38	0.40	0.55	0.50
18	1N334	70	90.8	90.8	0.0	1.1	0.0	1.1	0.36	0.36	0.58	0.54
19	1N335	70	90.9	90.8	0.1	1.1	0.0	1.1	0.34	0.35	0.56	0.52
20	1N431	80	93.1	90.9	2.2	13.7	4.5	9.1	0.37	0.37	0.48	0.47
21	1N531	80	90.9	90.2	0.6	4.7	2.1	2.6	0.47	0.47	0.62	0.61
22	1N631	75	88.0	87.5	0.5	3.4	1.8	1.6	0.33	0.33	0.39	0.34
23	1T131	75	86.4	86.2	0.2	2.0	1.5	0.5	0.40	0.40	0.42	0.41
24	1T231	70	85.7	85.1	0.6	1.2	0.2	0.9	0.36	0.46	0.55	0.46
25	1W031	80	87.7	87.4	0.3	8.9	8.6	0.2	0.41	0.41	0.55	0.54
26	2A031	70	91.3	90.7	0.6	2.5	0.0	2.5	0.35	0.35	0.49	0.48
27	2A137	70	89.6	89.3	0.3	1.1	0.0	1.0	0.51	0.51	0.64	0.59
28	2A331	70	91.1	90.8	0.2	0.8	0.0	0.8	0.37	0.37	0.51	0.50
29	2A332	70	90.4	90.1	0.3	1.7	0.0	1.7	0.43	0.43	0.57	0.56
30	2A333	70	n/a	n/a	n/a	0.2	0.2	0.0	n/a	n/a	n/a	n/a
31	2A431	75	85.9	84.6	1.4	10.8	7.5	3.3	0.53	0.55	0.71	0.66
32	2A531	70	85.5	85.2	0.4	1.1	0.6	0.6	0.48	0.49	0.59	0.59
33	2A533	70	90.5	90.3	0.2	1.1	0.0	1.1	0.34	0.34	0.49	0.49
34	2A631	70	88.2	87.9	0.2	1.1	0.1	1.1	0.44	0.44	0.50	0.49
35	2A632	80	87.6	87.0	0.6	8.1	8.7	-0.7	0.43	0.43	0.53	0.53
36	2A633	75	87.3	87.1	0.2	1.7	1.3	0.4	0.39	0.39	0.54	0.52
37	2A634	70	87.4	87.2	0.2	1.2	0.1	1.1	0.39	0.39	0.48	0.47
38	2A635	70	87.9	87.8	0.2	0.7	0.0	0.6	0.40	0.40	0.55	0.55
39	2A636	80	89.6	89.5	0.1	2.0	2.3	-0.3	0.49	0.49	0.65	0.65
40	2A731	80	89.6	89.6	0.0	1.6	1.0	0.5	0.48	0.48	0.59	0.58

Table 4. Summary of Estimation Results for FSG and Washout by AFS (cont'd)

			FSG			Washout Rates			R			
No.	AFSC	PV	Actual	Pred	Diff	Actual	Pred	Diff	Uncorr	Full AFS	USAF-wide	USAF-wide-cv
41	2A732	80	87.9	87.0	0.9	11.8	10.7	1.1	0.47	0.47	0.54	0.52
42	2A733	70	87.4	87.3	0.2	1.5	0.0	1.4	0.45	0.46	0.55	0.55
43	2A734	70	88.8	88.6	0.2	0.9	0.0	0.9	0.42	0.42	0.55	0.53
44	2E031	80	89.7	89.7	0.1	2.6	2.0	0.6	0.40	0.40	0.56	0.54
45	2E131	70	88.6	88.2	0.4	1.6	0.0	1.5	0.48	0.48	0.68	0.67
46	2E132	80	87.9	87.9	0.0	3.1	4.6	-1.6	0.40	0.41	0.58	0.56
47	2E133	80	89.1	88.9	0.3	3.7	3.4	0.3	0.42	0.42	0.59	0.59
48	2E231	80	87.3	87.2	0.1	6.6	7.6	-1.1	0.47	0.48	0.65	0.64
49	2E632	70	90.6	90.5	0.1	3.1	0.0	3.1	0.38	0.38	0.48	0.41
50	2E633	70	87.8	87.8	0.1	0.2	0.0	0.2	0.48	0.48	0.52	0.51
51	2F031	70	89.4	89.2	0.2	0.5	0.0	0.5	0.36	0.36	0.45	0.45
52	2G031	70	86.8	86.8	0.0	0.0	0.0	0.0	0.38	0.38	0.34	0.00
53	2M031	70	91.7	91.5	0.2	0.8	0.0	0.8	0.47	0.47	0.63	0.62
54	2M032	70	94.4	93.8	0.6	1.7	0.0	1.7	0.39	0.39	0.43	0.40
55	2M033	80	88.6	87.6	1.0	8.6	7.2	1.4	0.43	0.43	0.45	0.41
56	2P031	75	85.5	85.1	0.3	5.0	4.2	0.9	0.52	0.52	0.71	0.70
57	2R031	70	88.5	88.1	0.4	1.9	0.1	1.8	0.38	0.38	0.47	0.44
58	2R131	70	88.3	88.1	0.2	1.1	0.0	1.0	0.34	0.34	0.41	0.38
59	2S031	75	87.3	87.2	0.1	1.8	1.5	0.3	0.27	0.27	0.36	0.35
60	2S032	80	86.9	87.2	-0.3	4.3	4.5	-0.1	0.32	0.32	0.34	0.18
61	2T031	75	87.0	86.9	0.1	1.8	1.4	0.4	0.28	0.28	0.33	0.31
62	2T131	70	86.3	86.3	0.0	0.2	0.0	0.2	0.43	0.44	0.51	0.50
63	2T231	70	87.6	87.5	0.1	0.4	0.0	0.3	0.42	0.42	0.50	0.50
64	2T331	70	88.9	88.6	0.4	1.0	0.1	0.9	0.33	0.33	0.43	0.41
65	2T332	70	86.5	86.2	0.3	1.6	0.7	1.0	0.31	0.31	0.39	0.36
66	2T334	70	86.8	86.8	0.0	0.7	1.7	-1.0	0.12	0.12	0.17	0.00
67	2T337	70	85.3	85.2	0.1	0.0	1.0	-1.0	0.39	0.38	0.43	0.37
68	2W031	70	88.9	88.7	0.2	0.7	0.0	0.7	0.46	0.47	0.57	0.57
69	2W131	80	89.0	88.9	0.0	2.1	2.3	-0.2	0.49	0.49	0.53	0.52
70	2W231	70	92.5	91.8	0.7	3.5	0.0	3.5	0.45	0.45	0.55	0.53
71	3A031	75	85.7	85.5	0.2	3.0	3.3	-0.3	0.26	0.26	0.33	0.33
72	3C031	75	85.4	85.0	0.4	4.7	4.7	0.0	0.44	0.44	0.58	0.58
73	3C032	75	86.9	86.2	0.7	5.7	3.5	2.2	0.50	0.53	0.79	0.78
74	3C131	70	82.3	81.8	0.5	2.5	3.0	-0.5	0.42	0.42	0.47	0.42
75	3C231	75	85.3	83.5	1.8	14.0	10.9	3.0	0.38	0.39	0.55	0.54
76	3C331	75	82.5	81.7	0.8	12.9	14.1	-1.1	0.52	0.52	0.60	0.58
77	3E031	80	86.2	85.9	0.3	12.0	11.1	0.9	0.57	0.56	0.57	0.56
78	3E032	70	86.4	86.2	0.2	1.4	0.0	1.4	0.47	0.47	0.64	0.63
79	3E131	80	86.4	85.8	0.6	10.5	11.9	-1.4	0.41	0.41	0.55	0.53
80	3E231	70	91.2	91.1	0.1	0.4	0.0	0.4	0.41	0.41	0.59	0.57

Table 4. Summary of Estimation Results for FSG and Washout by AFS (cont'd)

			FSG			Washout Rates			R			
No.	AFSC	PV	Actual	Pred	Diff	Actual	Pred	Diff	Uncorr	Full AFS	USAF-wide	USAF-wide-cv
81	3E331	70	84.5	84.3	0.2	1.5	0.7	0.8	0.41	0.41	0.52	0.51
82	3E431	70	87.2	86.8	0.3	1.7	0.1	1.7	0.51	0.51	0.63	0.62
83	3E432	75	85.7	85.2	0.5	3.6	2.2	1.4	0.34	0.34	0.45	0.40
84	3E433	70	90.5	90.3	0.1	0.0	0.0	0.0	0.49	0.49	0.46	0.32
85	3E531	70	83.6	84.5	-0.9	0.5	3.1	-2.6	0.53	0.50	0.59	0.57
86	3E631	70	88.3	88.2	0.1	0.0	0.0	0.0	0.46	0.46	0.55	0.51
87	3E731	80	88.8	88.2	0.7	9.4	3.4	5.9	0.58	0.58	0.61	0.61
88	3E931	75	83.2	82.6	0.6	6.5	8.6	-2.1	0.45	0.46	0.57	0.56
89	3M031	70	83.3	83.1	0.2	2.6	1.4	1.2	0.36	0.36	0.40	0.40
90	3P031	75	81.7	82.3	-0.6	7.7	8.2	-0.5	0.49	0.49	0.54	0.54
91	3S031	70	88.2	87.9	0.3	1.3	0.1	1.2	0.32	0.32	0.41	0.40
92	4A031	70	86.1	86.0	0.0	0.2	0.2	0.0	0.43	0.43	0.47	0.46
93	4A131	70	84.3	84.1	0.2	1.5	0.7	0.8	0.24	0.24	0.32	0.29
94	4A231	80	85.6	82.3	3.2	36.0	37.7	-1.7	0.40	0.40	0.61	0.59
95	4C031	80	88.5	88.4	0.1	3.1	3.1	0.1	0.51	0.52	0.64	0.63
96	4D031	70	81.4	81.2	0.1	0.9	2.1	-1.2	0.65	0.65	0.70	0.68
97	4J032	75	84.8	83.8	0.9	8.0	6.8	1.2	0.45	0.45	0.56	0.49
98	4V031	70	90.1	89.8	0.3	1.1	0.0	1.0	0.22	0.22	0.22	0.00
99	4Y031	75	84.9	84.6	0.3	5.1	6.0	-0.9	0.37	0.37	0.44	0.43
100	4Y032	80	89.8	89.9	-0.1	1.8	1.0	0.8	0.37	0.38	0.49	0.41
101	5R031	70	84.9	84.9	0.0	0.0	0.3	-0.3	0.45	0.45	0.49	0.42
102	6C031	70	84.2	83.7	0.5	4.8	2.2	2.6	0.37	0.37	0.57	0.55
103	6F031	75	88.1	87.5	0.5	3.4	1.7	1.7	0.32	0.33	0.43	0.42
	MEAN		87.7	87.3	0.3	3.9	3.1	0.9	0.41	0.41	0.52	0.48
	MIN		81.4	81.2	-0.9	0.0	0.0	-2.6	0.12	0.12	0.17	0.00
	MAX		94.4	93.8	3.2	36.0	37.7	9.1	0.65	0.65	0.79	0.78

Table 5. Wasback Rates Among Airmen Passing and for the Full Sample by AFS

		Pass Sample			Full Sample*		
No.	AFSC	Total	# WB	Pct WB	Total	# WB	Pct WB
1	1A231	81	28	34.6	82	28	34.1
2	1A331	630	106	16.8	667	135	20.2
3	1A431	524	77	14.7	531	81	15.3
4	1A531	147	25	17.0	151	26	17.2
5	1A831	196	24	12.2	200	26	13.0
6	1C031	318	29	9.1	334	38	11.4
7	1C032	606	64	10.6	632	79	12.5
8	1C131	1,672	333	19.9	1,903	427	22.4
9	1C231	157	38	24.2	167	46	27.5
10	1C331	789	50	6.3	808	63	7.8
11	1C431	443	146	33.0	536	216	40.3
12	1C531	769	41	5.3	776	45	5.8
13	1C631	274	2	0.7	292	4	1.4
14	1N031	1,224	259	21.2	1,461	441	30.2
15	1N131	564	81	14.4	603	112	18.6
16	1N332	95	19	20.0	96	20	20.8
17	1N333	164	19	11.6	167	22	13.2
18	1N334	181	19	10.5	183	21	11.5
19	1N335	177	11	6.2	179	13	7.3
20	1N431	631	225	35.7	731	314	43.0
21	1N531	405	45	11.1	425	58	13.6
22	1N631	224	17	7.6	232	20	8.6
23	1T131	737	120	16.3	752	135	18.0
24	1T231	85	16	18.8	86	16	18.6
25	1W031	952	274	28.8	1,045	357	34.2
26	2A031	813	140	17.2	834	155	18.6
27	2A137	93	23	24.7	94	24	25.5
28	2A331	856	101	11.8	863	103	11.9
29	2A332	1,083	127	11.7	1,102	141	12.8
30	2A333	4,248	900	21.2	4,257	902	21.2
31	2A431	66	23	34.8	74	31	41.9
32	2A531	4,350	641	14.7	4,399	678	15.4
33	2A533	2,201	324	14.7	2,225	343	15.4
34	2A631	2,502	438	17.5	2,531	464	18.3
35	2A632	1,713	409	23.9	1,863	546	29.3
36	2A633	521	55	10.6	530	64	12.1
37	2A634	1,154	116	10.1	1,168	126	10.8
38	2A635	864	106	12.3	870	111	12.8
39	2A636	1,794	283	15.8	1,831	317	17.3
40	2A731	381	48	12.6	387	52	13.4

* Excludes washouts attributable to non-academic reasons other than medical.

Table 5. Wasback Rates Among Airmen Passing and for the Full Sample by AFS (cont'd)

		Pass Sample			Full Sample*		
No.	AFSC	Total	# WB	Pct WB	Total	# WB	Pct WB
41	2A732	367	105	28.6	416	145	34.9
42	2A733	1,426	214	15.0	1,447	231	16.0
43	2A734	342	34	9.9	345	37	10.7
44	2E031	297	65	21.9	305	69	22.6
45	2E131	824	197	23.9	837	209	25.0
46	2E132	254	71	28.0	262	77	29.4
47	2E133	1,187	306	25.8	1,232	346	28.1
48	2E231	1,238	376	30.4	1,325	449	33.9
49	2E632	127	36	28.3	131	38	29.0
50	2E633	569	153	26.9	570	154	27.0
51	2F031	2,034	144	7.1	2,045	154	7.5
52	2G031	78	9	11.5	78	9	11.5
53	2M031	511	51	10.0	515	52	10.1
54	2M032	282	5	1.8	287	5	1.7
55	2M033	191	47	24.6	209	55	26.3
56	2P031	320	61	19.1	337	70	20.8
57	2R031	258	53	20.5	263	58	22.1
58	2R131	368	45	12.2	372	48	12.9
59	2S031	2,610	352	13.5	2,657	389	14.6
60	2S032	110	5	4.5	115	5	4.3
61	2T031	703	117	16.6	716	127	17.7
62	2T131	1,036	40	3.9	1,038	42	4.0
63	2T231	2,546	227	8.9	2,555	235	9.2
64	2T331	519	35	6.7	524	39	7.4
65	2T332	362	18	5.0	368	22	6.0
66	2T334	300	19	6.3	302	21	7.0
67	2T337	166	4	2.4	166	4	2.4
68	2W031	3,579	365	10.2	3,606	388	10.8
69	2W131	3,549	279	7.9	3,626	336	9.3
70	2W231	413	41	9.9	428	54	12.6
71	3A031	2,420	533	22.0	2,496	603	24.2
72	3C031	2,291	446	19.5	2,403	546	22.7
73	3C032	548	89	16.2	581	120	20.7
74	3C131	196	29	14.8	201	32	15.9
75	3C231	771	199	25.8	896	308	34.4
76	3C331	182	38	20.9	209	61	29.2
77	3E031	566	139	24.6	643	206	32.0
78	3E032	688	38	5.5	698	46	6.6
79	3E131	531	132	24.9	593	190	32.0
80	3E231	446	60	13.5	448	61	13.6

* Excludes washouts attributable to non-academic reasons other than medical.

Table 5. Wasback Rates Among Airmen Passing and for the Full Sample by AFS (cont'd)

		Pass Sample			Full Sample*		
No.	**AFSC**	**Total**	**# WB**	**Pct WB**	**Total**	**# WB**	**Pct WB**
81	3E331	453	48	10.6	460	53	11.5
82	3E431	565	68	12.0	575	78	13.6
83	3E432	161	10	6.2	167	14	8.4
84	3E433	74	2	2.7	74	2	2.7
85	3E531	205	15	7.3	206	16	7.8
86	3E631	178	5	2.8	178	5	2.8
87	3E731	1,531	408	26.6	1,689	534	31.6
88	3E931	388	120	30.9	415	141	34.0
89	3M031	2,059	219	10.6	2,115	253	12.0
90	3P031	15,064	2,635	17.5	16,320	3,442	21.1
91	3S031	1,492	282	18.9	1,512	300	19.8
92	4A031	1,447	74	5.1	1,450	75	5.2
93	4A131	528	23	4.4	536	24	4.5
94	4A231	169	47	27.8	264	115	43.6
95	4C031	309	6	1.9	319	9	2.8
96	4D031	227	5	2.2	229	5	2.2
97	4J032	92	0	0.0	100	0	0.0
98	4V031	94	0	0.0	95	0	0.0
99	4Y031	923	99	10.7	973	134	13.8
100	4Y032	108	11	10.2	110	11	10.0
101	5R031	123	2	1.6	123	2	1.6
102	6C031	319	10	3.1	335	17	5.1
103	6F031	1,067	160	15.0	1,105	192	17.4
	Overall	97,465	15,228	15.6	101,662	18,263	18.0

* Excludes washouts attributable to non-academic reasons other than medical.

Computing Average FSG and Washout Rate

This section describes the key steps for computing the average FSG and washout rate produced by CDSS. Both computations start by identifying the subsample of airmen from the total sample of USAF accessions (or applicants) that qualify for an AFS given the specified minimum aptitude standard(s). Next, one estimates the predicted FSG and washout behavior for the sample of qualified airmen. Finally, one obtains the average across the qualified airmen on the corresponding outcome. Note that except for the extra step involved in the computation of the washout rate, the two methods outlined below are exactly the same.

Steps for Computing the Estimated Average FSG for an AFS

1. Identify the subsample of airmen qualifying for the targeted AFS using the specified minimum aptitude standard(s). This sample is denoted below by the set A_Q.

2. Compute the estimated FSGs for the airmen constituting A_Q using the formula below. In this formula, the $\hat{B}$ s are the estimated constants and coefficients corresponding to the AFS and are reported in Table 6. The X_i s are the values of the *i*th airman's demographic characteristics and MAGE composite scores and $\hat{Y}_i$ equals his/her predicted FSG for the AFS.

$$\hat{Y}_i = \hat{B}_{const} + \hat{B}_{Fem} X_{i,Fem} + \hat{B}_M X_{i,M} + \hat{B}_A X_{i,A} + \hat{B}_G X_{i,G} + \hat{B}_E X_{i,E}$$

3. Average the predicted FSGs $\hat{Y}_i$ s for all airmen constituting A_Q in Step 2, as summarized by the formula below. The denominator N_Q is the number of airmen who qualify for the AFS based on the specified minimum aptitude standard(s). The average FSG for the AFS generated by CDSS equals $\overline{Y}$.

$$\overline{Y} = \frac{\sum_{i \in A_Q} \hat{Y}_i}{N_Q}$$

Steps for Computing the Estimated Washout Rate for an AFS

1. Identify the subsample of airmen qualifying for the targeted AFS using the specified minimum aptitude standard(s). This sample is denoted below by the set A_Q..

2. Compute the estimated FSGs for the airmen constituting A_Q using the formula below. In this formula, the $\hat{B}$ s are the estimated constants and coefficients corresponding to the AFS and are reported in Table 6. The X_i s are the values of the *i*th airman"s demographic characteristics and MAGE composite scores and $\hat{Y}_i$ equals his/her predicted FSG for the AFS.

$$\hat{Y}_i = \hat{B}_{const} + \hat{B}_{Fem} X_{i,Fem} + \hat{B}_M X_{i,M} + \hat{B}_A X_{i,A} + \hat{B}_G X_{i,G} + \hat{B}_E X_{i,E}$$

3. Compute the probability of washing out from the AFS for the airmen constituting A_Q using the formula below. The $\hat{Y}_i$ s that appear in the numerator below are the estimated FSG of airmen produced in Step 2. The quantities $\hat{\sigma}_\varepsilon$ and PV are the estimated RMSE (root mean squared error) and passing FSG value, respectively, corresponding to the AFS; MSEs and passing values for all AFSs are reported in Table 6.

$$\hat{P}_{i,attr} = \Phi\left(\frac{PV - \hat{Y}_i}{\hat{\sigma}_\varepsilon}\right)$$

4. Average the washout probabilities $\hat{P}_{i,attr}$ s computed for the airmen constituting A_Q, as summarized by the formula below. The denominator N_Q is the number of airmen who qualify for the AFS based on the specified minimum aptitude standard(s). The estimated washout rate for the AFS produced by CDSS equals $\overline{P}$.

$$\overline{P}_{attr} = \frac{\sum_{i \in A_Q} \hat{P}_{i,attr}}{N_Q}$$

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Appendix A: Parameter Estimates

Table 6. FSG and Attrition Model Parameter Estimates by AFS

AFS	bConst	bFemale	bM	bA	bG	bE	RMSE	PV
1A2X1	76.40802	1.19303	0.03807	0.06368	0.00643	0.08168	3.60935	70
1A3X1	69.05427	0.56896	0.03516	0.06301	-0.01853	0.13981	4.13848	80
1A4X1	79.89186	-1.88250	-0.00715	0.01393	0.02682	0.10551	4.02185	80
1A5X1	75.52045	-1.29522	0.10693	0.05798	-0.01949	0.02557	3.49692	80
1A8X1	84.62425	1.13903	-0.01648	-0.00842	0.07398	0.02327	3.88301	70
1C0X1	75.71419	1.25715	0.05880	0.07083	0.00394	0.01777	5.57232	75
1C0X2	72.57463	1.42640	-0.02114	0.09711	0.05830	0.05384	6.44534	70
1C1X1	72.79755	-1.44760	-0.03393	0.10818	0.01487	-0.04781	5.00000	70
1C2X1	77.87702	0.00000	0.00634	0.02823	-0.05670	0.15979	3.63316	80
1C3X1	77.85232	0.13396	0.05208	0.11796	-0.03107	0.02906	5.60970	75
1C4X1	74.13978	0.00000	0.05272	0.06146	0.00901	0.04189	4.14407	80
1C5X1A	78.00175	0.47947	0.04504	0.07018	0.01890	0.01062	5.44275	70
1C5X1B	78.00175	0.47947	0.04504	0.07018	0.01890	0.01062	5.44275	70
1C6X1	79.38508	-0.95122	-0.02802	0.04327	0.07608	0.06072	4.23405	80
1N0X1	68.94084	-0.17863	0.00946	0.11587	0.07209	0.02556	4.71636	80
1N1X1	73.68987	-0.73488	0.08380	0.05787	0.02022	0.02048	3.96898	80
1N3X2	91.29452	-0.19462	-0.03060	-0.05479	0.02222	0.06314	2.22000	70
1N3X3	76.93587	-1.21246	0.01588	0.12777	-0.03964	0.05323	3.88204	70
1N3X4	83.30541	0.70858	0.03994	-0.08013	0.01811	0.11294	2.86217	70
1N3X5	76.91160	0.39565	-0.01782	0.11755	-0.02326	0.07627	2.85868	70
1N4X1	73.54470	2.10281	-0.00486	0.07288	0.08999	0.06499	5.96497	80
1N5X1	72.67715	0.97718	0.08466	0.12606	-0.03188	0.04036	4.43354	80
1N6X1	78.08765	-0.32203	0.07415	0.10926	-0.11959	0.06861	5.65311	75
1T1X1	79.06229	0.73610	0.09493	0.05184	-0.06309	0.05375	4.83003	75
1T2X1	70.70324	0.00000	0.09894	0.07776	0.00156	0.00429	4.56166	70
1W0X1A	70.27623	-0.10697	0.05906	0.08578	0.02291	0.05574	4.81430	80
2A0X1A	76.91762	1.34908	0.05550	0.07502	-0.01413	0.05798	4.88386	70
2A0X1B	76.91762	1.34908	0.05550	0.07502	-0.01413	0.05798	4.88386	70
2A0X1C	76.91762	1.34908	0.05550	0.07502	-0.01413	0.05798	4.88386	70
2A0X1D	76.91762	1.34908	0.05550	0.07502	-0.01413	0.05798	4.88386	70
2A1X7	72.17316	0.00000	0.13925	0.13947	-0.00807	-0.04224	4.76484	70
2A3X1A	78.55696	-0.21128	0.05251	0.07742	-0.02002	0.04784	4.51342	70
2A3X1B	78.55696	-0.21128	0.05251	0.07742	-0.02002	0.04784	4.51342	70
2A3X1C	78.55696	-0.21128	0.05251	0.07742	-0.02002	0.04784	4.51342	70
2A3X2	77.54654	-0.04781	0.05415	0.07002	0.00355	0.03581	4.37788	70
2A3X3A	82.47983	-2.11707	0.06645	-0.03305	-0.03928	0.03901	5.00000	70
2A3X3B	82.47983	-2.11707	0.06645	-0.03305	-0.03928	0.03901	5.00000	70
2A3X3E	82.47983	-2.11707	0.06645	-0.03305	-0.03928	0.03901	5.00000	70
2A3X3F	82.47983	-2.11707	0.06645	-0.03305	-0.03928	0.03901	5.00000	70
2A3X3G	82.47983	-2.11707	0.06645	-0.03305	-0.03928	0.03901	5.00000	70
2A3X3H	82.47983	-2.11707	0.06645	-0.03305	-0.03928	0.03901	5.00000	70
2A3X3J	82.47983	-2.11707	0.06645	-0.03305	-0.03928	0.03901	5.00000	70
2A4X1	56.86977	0.12862	0.06026	0.14117	0.01804	0.13966	5.53307	75
2A5X1A	71.91634	-0.15255	0.15378	0.02425	-0.06126	0.08073	5.35436	70
2A5X1B	71.91634	-0.15255	0.15378	0.02425	-0.06126	0.08073	5.35436	70
2A5X1C	71.91634	-0.15255	0.15378	0.02425	-0.06126	0.08073	5.35436	70
2A5X1D	71.91634	-0.15255	0.15378	0.02425	-0.06126	0.08073	5.35436	70
2A5X1E	71.91634	-0.15255	0.15378	0.02425	-0.06126	0.08073	5.35436	70

Table 6. FSG and Attrition Model Parameter Estimates by AFS (cont'd)

AFS	bConst	bFemale	bM	bA	bG	bE	RMSE	PV
2A5X1F	71.91634	-0.15255	0.15378	0.02425	-0.06126	0.08073	5.35436	70
2A5X1G	71.91634	-0.15255	0.15378	0.02425	-0.06126	0.08073	5.35436	70
2A5X1H	71.91634	-0.15255	0.15378	0.02425	-0.06126	0.08073	5.35436	70
2A5X3A	77.93829	0.42909	0.03954	0.05429	-0.00825	0.07214	4.34336	70
2A5X3B	77.93829	0.42909	0.03954	0.05429	-0.00825	0.07214	4.34336	70
2A5X3C	77.93829	0.42909	0.03954	0.05429	-0.00825	0.07214	4.34336	70
2A6X1B	77.84016	0.08173	0.11424	0.05287	-0.02743	0.02667	5.24603	70
2A6X1C	77.84016	0.08173	0.11424	0.05287	-0.02743	0.02667	5.24603	70
2A6X1D	77.84016	0.08173	0.11424	0.05287	-0.02743	0.02667	5.24603	70
2A6X1E	77.84016	0.08173	0.11424	0.05287	-0.02743	0.02667	5.24603	70
2A6X2	76.08815	-0.78672	0.07777	0.03148	-0.00058	0.06504	4.65134	80
2A6X3	74.39123	-1.10507	0.10080	0.05552	-0.03685	0.06363	5.03104	75
2A6X4	77.25248	0.18136	0.09258	0.02560	-0.03187	0.07160	4.90501	70
2A6X5	75.21677	-0.14477	0.12753	0.04480	-0.06474	0.07497	4.94981	70
2A6X6	74.13058	-0.09562	0.08956	0.06156	-0.03546	0.09826	4.22586	80
2A7X1	80.25397	-0.68790	0.08148	0.00979	-0.01882	0.06680	3.71428	80
2A7X2	75.62018	0.08027	0.01692	0.00721	0.04531	0.13610	4.89213	80
2A7X3	76.17380	1.15101	0.11084	0.03078	-0.03137	0.06152	4.54335	70
2A7X4	78.82147	0.52436	0.10697	0.05650	-0.01696	0.02479	4.55068	70
2E0X1	77.54313	-0.51741	0.02666	0.03903	0.01796	0.07031	4.44496	80
2E1X1	67.67352	-0.29206	0.03632	0.07606	0.00141	0.14599	4.67158	70
2E1X2	74.85845	-0.92267	0.04290	0.06130	-0.01088	0.07665	4.34567	80
2E1X3	74.13866	0.64177	0.05487	0.03020	-0.00091	0.10552	4.45613	80
2E2X1	69.15986	-1.00236	0.04871	0.09844	-0.01321	0.09359	4.45970	80
2E6X2	83.14231	1.13804	0.03034	0.00947	-0.01499	0.09354	3.79612	70
2E6X3	78.16426	-0.22656	-0.01132	0.02492	0.04079	0.09483	4.09119	70
2F0X1	80.15234	-0.34180	0.05779	0.04426	-0.00602	0.04458	4.88957	70
2G0X1	82.11382	-1.02538	-0.02538	-0.00069	0.08642	0.02612	4.49932	70
2M0X1A	77.27297	0.07785	0.02302	0.06287	0.01896	0.07460	4.01057	70
2M0X1B	77.27297	0.07785	0.02302	0.06287	0.01896	0.07460	4.01057	70
2M0X2	88.51344	0.59824	0.03873	0.01680	0.02458	0.00238	4.18990	70
2M0X3	78.71560	0.41255	0.03155	0.02198	0.04671	0.05321	4.74328	80
2P0X1	62.04230	-1.12404	0.05259	0.08293	0.02533	0.13106	5.09315	75
2R0X1	75.64402	0.70948	-0.03849	0.05973	0.04142	0.10726	5.52007	70
2R1X1	79.48812	0.30101	0.01446	0.09105	0.05643	-0.01653	5.19065	70
2S0X1	79.66131	0.61851	-0.03842	0.08363	0.02461	0.05608	5.45213	75
2S0X2	84.31826	0.59094	-0.05092	-0.03557	0.03172	0.10625	4.05439	80
2T0X1	80.37934	1.54565	-0.01871	0.05789	0.06635	0.00661	5.22069	75
2T1X1	76.47527	0.47313	0.01894	0.03656	0.02635	0.08522	4.47101	70
2T2X1	76.30014	1.13075	0.05070	0.05286	0.00851	0.06094	4.81554	70
2T3X1	81.69556	-0.29246	0.06318	-0.07606	-0.00612	0.12705	5.44109	70
2T3X2A	79.19690	-1.66329	0.06083	-0.00345	-0.00920	0.07466	6.27824	70
2T3X2B	79.19690	-1.66329	0.06083	-0.00345	-0.00920	0.07466	6.27824	70
2T3X2C	79.19690	-1.66329	0.06083	-0.00345	-0.00920	0.07466	6.27824	70
2T3X4	81.70738	-0.33078	0.05658	0.01994	-0.03709	0.03771	7.82864	70
2T3X7	77.58452	0.66394	-0.09161	-0.01543	0.16096	0.09885	6.12691	70
2W0X1	75.54493	-0.06507	0.06692	0.05883	-0.00022	0.06194	4.52253	70
2W1X1C	80.28320	0.14200	0.07201	0.04259	-0.02398	0.05353	4.04141	80

Table 6. FSG and Attrition Model Parameter Estimates by AFS (cont'd)

AFS	bConst	bFemale	bM	bA	bG	bE	RMSE	PV
2W1X1D	80.28320	0.14200	0.07201	0.04259	-0.02398	0.05353	4.04141	80
2W1X1E	80.28320	0.14200	0.07201	0.04259	-0.02398	0.05353	4.04141	80
2W1X1F	80.28320	0.14200	0.07201	0.04259	-0.02398	0.05353	4.04141	80
2W1X1H	80.28320	0.14200	0.07201	0.04259	-0.02398	0.05353	4.04141	80
2W1X1K	80.28320	0.14200	0.07201	0.04259	-0.02398	0.05353	4.04141	80
2W1X1L	80.28320	0.14200	0.07201	0.04259	-0.02398	0.05353	4.04141	80
2W1X1Z	80.28320	0.14200	0.07201	0.04259	-0.02398	0.05353	4.04141	80
2W2X1	79.86851	1.40767	0.05995	0.03386	-0.07158	0.13561	4.52673	70
3A0X1	79.58680	0.59468	0.01621	0.03216	0.02355	0.04702	5.58337	75
3C0X1	66.32756	-0.53855	0.03135	0.09045	0.04938	0.07415	5.34939	75
3C0X2	47.83542	1.35935	0.07640	0.23068	-0.00892	0.12485	5.01232	75
3C1X1	71.20710	1.69151	-0.04944	0.04983	0.16967	0.01833	5.77186	70
3C2X1	60.93067	1.63157	0.05404	0.07028	0.01268	0.15421	6.26912	75
3C3X1	64.06875	-2.69864	0.06371	0.12341	0.05960	-0.00944	5.27691	75
3E0X1	75.96302	0.86421	0.05962	0.03000	-0.02354	0.11135	3.98312	80
3E0X2	72.46868	-0.82099	0.09625	0.04099	-0.06581	0.12151	4.19856	70
3E1X1	77.07158	0.53613	0.05704	0.02653	0.01824	0.08536	4.53352	80
3E2X1	84.42504	-2.95994	0.04867	0.03639	-0.05695	0.08129	3.61354	70
3E3X1	71.67846	-0.63569	0.09066	0.06318	0.01065	0.03741	5.40476	70
3E4X1	74.01412	0.38667	0.10476	0.01548	-0.03230	0.11636	4.77090	70
3E4X2	78.21146	-1.00502	0.09656	0.00424	-0.02479	0.04517	4.81070	75
3E4X3	85.28749	-0.64423	0.02005	0.13444	-0.10098	0.03320	3.57685	70
3E5X1	59.70371	-0.68952	-0.07364	0.24985	-0.02982	0.16760	6.52049	70
3E6X1	76.20126	0.93782	0.02738	0.07196	-0.00108	0.10291	4.96493	70
3E7X1	78.82866	-0.18760	0.09160	0.02983	-0.00904	0.05239	3.80322	80
3E9X1	67.14270	1.06584	0.02457	0.11303	0.01995	0.05021	5.04548	75
3M0X1	73.93269	1.53602	0.02803	0.05957	0.02731	0.04316	5.63439	70
3P0X1	73.37436	-0.28002	0.06795	0.07347	0.00503	0.01841	4.73357	75
3S0X1	78.38164	1.44569	-0.02282	0.09269	0.05979	0.02358	5.67624	70
4A0X1	74.06658	2.07070	-0.01760	0.10142	0.01889	0.06998	5.08278	70
4A1X1	76.04987	0.72436	-0.00922	0.07230	0.05211	0.01036	5.51589	70
4A2X1	60.50854	0.24291	0.00527	-0.04147	0.05574	0.25699	6.74645	80
4C0X1	71.66464	2.21016	-0.04546	0.07092	0.12417	0.06237	3.81281	80
4D0X1	63.47256	2.61402	0.03789	0.09390	0.03294	0.11675	4.30981	70
4J0X2A	69.39278	-1.31887	-0.08002	-0.00126	0.25174	0.04052	5.23197	75
4V0X1A	86.22013	0.91065	0.03366	0.01277	-0.12592	0.12644	5.07907	70
4Y0X1	72.46771	2.22601	0.03421	0.05715	0.02939	0.07016	5.70442	75
4Y0X2	77.58838	1.37041	-0.01391	0.06556	0.09783	-0.00375	3.90219	80
5R0X1	72.67037	1.81622	-0.01221	0.13259	0.01188	0.04526	4.81059	70
6C0X1	61.38203	0.13727	-0.00559	0.17223	0.10629	-0.00242	6.36363	70
6F0X1	73.76239	1.54532	-0.03328	0.09239	0.10647	0.00727	5.57725	75